Schematic of Two-Color LIF

Test field: Seeded by Rhodamine-B and Rhodamine-110

520-nm Rh-110 Emission

575-nm Rh-B Emission

Laser sheet

Blue Ar-ion Laser (488 nm)

CCD 1

PC pixel gray-level ratio manipulator

(A)

Dependence of LIF Image Intensity on Temperature

(B)

Two-Color LIF Image Calibration against Temperature

(C)

Thermally Stratified Water Channel

(D)

(E)

(F)

(G)

Two-Color (Rh-B & Rh-110) Laser Induced Fluorescence (LIF) Thermometry with Sub-Millimeter Measurement Resolution

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Two-color laser induced fluorescence (LIF) technique (Inset A) uses two fluorescence dyes with different emission characteristics – one is the temperature sensitive dye (Rhodamine-B) and the other is the temperature insensitive dye (Rhodamine-110). The ratio of the two fluorescence emission intensities, therefore, provides a calibrated correlation with temperature that does not depend on the laser illumination intensity variation and is free from the possible bias occurring from background noise (Insets B & C). The developed technique measures thermally stratified water layers with known linear temperature distributions. The Inset D shows "false-color" images of the intensity ratios measured for 10-mm cuvette, and the Insets E and F, for 1-mm cuvette. The temperature data, converted from these images (E, F) using the calibration (C), shows fairly accurate comparison with the theory (Inset G). The minimal spatial resolution is estimated to 10 μm and the maximum data uncertainty for a spatial resolution of 300μm by 200μm is estimated to be ±1.45 °C with a 95% confidence interval.